

the metals mined, a value of 2,508,200*l.* having been recovered in 1910. It occurs chiefly as free gold, but alloyed with a varying quantity of silver, and is found disseminated through various rocks, *e.g.* granite syenite, granulite, various schists, ironstone, and quartzite; but quartz veins traversing various rocks are the dominant gold carriers, all situated close to the granite contact. These veins vary greatly in width, and also in yield, the average yield for 1910 being 30*s.* 9*d.* per ton milled.

Nearly all the mines are situated on old native workings, and the quantity of gold taken from these workings, which sometimes attain a depth of over 200 feet, must have been considerable.

The blunders of pioneer mining companies and resultant financial difficulties have furnished a rich harvest for tributers, who have made handsome profits.

In a large number of the reefs a serious falling off in values is encountered at the water level, their payability down to that point apparently being due to secondary enrichment.

The conditions of Rhodesia are not favourable to the formation of extensive alluvial deposits, and very little gold has been derived from that source.

Other metals than gold are coming increasingly into prominence. Chromite has been mined continuously and with a progressive output since 1905 from a hill of the mineral at Selukwe, the output in 1910 being 44,000 tons, of a value of 98,130*l.*, most of the mineral being shipped to America.

Wolfram and scheelite have been produced in the Buluwayo and Hartley districts of a total value of 10,930*l.*

Nickel and cobalt have not been found, but the author describes their mode of occurrence and the characters of the minerals at Sudbury and New Caledonia as a guide for prospectors.

Copper ores are very widespread in Rhodesia, and the author describes the Kansanshe, Bwana M'Kubwe, and Umkondo and Alaska deposits, on all of which there have been extensive old workings, those on the Alaska extending in an almost unbroken line for about 1700 feet with an extreme width of 660 feet, and have been proved to go down in some places to a depth of at least 70 feet. The copper so far exposed is mainly in the form of malachite, the sulphide zone not having yet been reached. It is disseminated through a crushed belt of limestone.

Lead and zinc are found as an enormous body in the well-known occurrence at Broken Hill, which is remarkable for the large development of phosphates of lead and zinc within the zone of oxidation. The Penhalonga Gold Mine has yielded lead as a by-product.

Molybdenite occurs on the farm Appingadam. Bismuth and antimony have only as yet been found in Rhodesia with the gold ores rendering them refractory. The output of silver is obtained mainly as a by-product in the treatment of gold ores, and partly from the argentiferous galena of the Penhalonga Mine, but no true silver minerals have as yet been found.

A chapter is also devoted to the non-metalliferous minerals of Rhodesia, which, while interesting, space

does not permit us to notice, and the book concludes with a chapter giving hints to prospectors which they will find of interest.

Generally speaking, the book is clearly written, and contains a good deal of information; it should be in the hands of anyone who is devoting his attention to prospecting in Rhodesia.

THE FOUNDATIONS OF SCIENCE.

Die logischen Grundlagen der exakten Wissenschaften. By Prof. Paul Natorp. Pp. xx+416. (Leipzig and Berlin: B. G. Teubner, 1910.) Price 6.60 marks.

Probleme der Wissenschaft. By Federigo Enriques. Uebersetzt von Kurt Grelling. Erster Teil, Wirklichkeit und Logik. Pp. x+258+16. Price 4 marks. Zweiter Teil, Die Grundbegriffe. Pp. vi+259-599. Price 5 marks. (Leipzig and Berlin: B. G. Teubner, 1910.)

THE publication of these works, and, indeed, of the whole series to which they belong, furnishes further evidence for the revival of the interest in the ultimate problems of science, an interest which becomes very much alive so soon as an important branch of investigation reaches the borders of the knowable, and stands in danger of losing itself in unphilosophic disputations. Such an event is at present taking place in physics in connection with the relativity hypothesis, and before we reach the end of the controversy the logical foundations of science will have been thoroughly overhauled.

Prof. Natorp's work is practically a treatise on the fundamental principles of mathematics. It deals with such subjects as infinity and continuity, direction and dimension as determining pure number, time and space as mathematical structures, and the temporal and spatial arrangement of events. The treatment of the problems touched upon is detailed and thorough, and often leads to very decided (and, let us hope, decisive) pronouncements on present-day problems, as when the author declares it to be impossible to decide between the Euclidean or non-Euclidean structure of our space by means of any imaginable physical experiments. A brief summary of the new Principle of Relativity as formulated by Lorentz, Einstein, and Minkowski concludes a very informing and valuable work.

Prof. Enriques's two volumes are more practical and empirical, and will probably appeal to a wider circle of readers than Prof. Natorp's. The style is vigorous, and sometimes distinctly informal, and for that very reason the book is more readable than is the average work on these recondite subjects. His definition of "reality" is interesting. "Our belief in the reality of a thing," he says (p. 85), "supposes a totality of sensations which follow invariably upon certain conditions arbitrarily provided." This, as the author himself perceives, does not eliminate the possibility of a complex hallucination, unless we assume that the will is entirely in abeyance during hallucination. Those who prefer to regard reality as simply the "hallucination" common to the majority of mankind

will scarcely be won over by the author's attempt to attain a definition more flattering to our self-esteem. A terse definition of reality as "an invariant in the relation between volition and sensations" (p. 100) expresses very aptly the author's point of view. The chapter on the physiological bases of logic brings out clearly the author's ultra-modern methods, and his treatment of non-Euclidean geometry shows that he is not greatly out of sympathy with Poincaré's demand to regard all postulates, not as fundamental verities, but as mere mutual agreements among philosophers.

The last chapters of the book deal with the root laws of mechanics and physics in a brilliant and entertaining manner, including, of course, the Principle of Relativity. In the treatment of the latter, it is regrettable that the author stopped at the Fitzgerald-Lorentz contraction without going on to Einstein's all-important work. His final *tour de force* is to show that freedom and necessity are not incompatible, inasmuch as there is a necessity for freedom in biological processes. That, at all events, seems the most concise way of putting his argument.

OUR BOOK SHELF.

The Book of Buchan: a Scientific Treatise, in Six Sections, on the Natural History of Buchan, Prehistoric Man in Aberdeenshire, and the History of the North-east in Ancient, Medieval, and Modern Times. By Twenty-nine Contributors. Edited and arranged by J. F. Tocher. Pp. xxi+508. (Peterhead: The Buchan Club, 1910.) Price 10s. 6d.

THIS is a compendium of essays, somewhat on the lines of the Victoria County Histories, dealing with the natural history, archæology, and history of a district of north-east Aberdeenshire, known from ancient times by the name of Buchan. The essays, which are published by the local Field Club and edited by its secretary, are of varying degrees of merit. There are excellent essays on the geology of the district by Mr. A. W. Gibb and Dr. T. F. Jamieson. Prof. J. A. Thomson gives an admirable sketch of the fauna of the district and their origin. Prof. Trail deals with the flora in an essay which is chiefly concerned with pointing out the imperfections of the present knowledge of the subject, and urging the local botanists to complete the survey which he himself has so well begun. A valuable essay on "Stone Cists in Aberdeenshire" is contributed by Prof. R. W. Reid, to which are added tables of measurements of the skulls and limbs of the remarkable race which inhabited east Aberdeenshire in the late Neolithic and early Bronze age. Important contributions also bearing on the prehistory of the district at the same epoch are "The Prehistoric Pottery of Buchan," by the Hon. John Abercromby, and "Some Notes on the Stone Circles of Aberdeenshire," by Sir Norman Lockyer. These essays represent the latest views on these interesting archæological questions by acknowledged authorities.

The remainder of the volume deals with the history of Buchan from the beginning of history up to modern times. Some of these contributions show evidence of considerable research and mastery of the subject, notably that on "Life in the Northern Burghs before the Reformation," by Dr. P. Giles, of Cambridge.

Many of the contributions are, however, not up to the above high standard. We have an essay on Gaelic place-names of a type which usually is produced by

the Celtic scholar with insufficient knowledge of philology, who relies chiefly on picking out words of similar sounds from a Gaelic dictionary. It is not surprising either that the editor, who writes with an air of great authority on nearly all the various subjects dealt with in the volume, should sometimes be caught tripping. We find him waxing enthusiastic about the maps of Ptolemy, evidently ignorant of the fact that there is no evidence that Ptolemy ever drew any maps, all the so-called maps of Ptolemy having been drawn by modern geographers from Ptolemy's descriptions. He also ascribes the writings of Bede to the seventh instead of to the eighth century.

On the whole, however, the volume is a credit to the science and scholarship of Aberdeenshire.

The Senior Botany. By Prof. F. Cavers. Pp. vii+484. (London: University Tutorial Press, Ltd., 1910.) Price 4s. 6d.

LIKE the three earlier text-books which Prof. Cavers has prepared for this series, the present work is admirably designed to portray the plant as a living entity, to indicate how structure is subservient to function, and to show that conditions and purpose underlie the manifold variations which plants assume. Much of the earlier chapters has appeared in one or other of the former books; the broad bean plant is selected as the introductory type, and the same satisfactory arrangement of information supplemented by experiment is adopted. Although a chapter is devoted to the microscope and cell structure, evidence requiring microscopic examination is generally avoided.

Photosynthesis is taken as the starting point for explaining metabolism, and the attractive theory, for which, however, further proof is required, of a conversion from light to electrical energy as the crucial operating factor is definitely formulated. Incidentally it is suggested that carbon assimilation is a more suitable expression than photosynthesis, but this depends upon the application of the term assimilation. Here, too, it seems desirable to raise a protest against the use of the word "stomate" on the grounds that "stoma" is more correct, and used generally, if not universally, by the best authorities. Among the various forms of transpiration measuring instruments, the best and simplest is not given; also it is observed that the interesting subject of soil physics is omitted except to advise reference to agricultural books.

There is an extensive chapter on ecology, which, with the chapters on flowers, classification, fruits and seeds, deserve special praise, as they are all explicit, stimulating, and copiously packed with detail; a few minor points of criticism arise, notably the description of monocotyledons as a lower class than the dicotyledons.

It should be understood that the qualification "senior" refers to the local examinations of Oxford and Cambridge. The book is well adapted for its purpose, although there is more information than most pupils in schools could assimilate; in addition, it can be strongly recommended to students in the polytechnics as a sound guide to the study of plant-life.

Praktikum der experimentellen Mineralogie mit Berücksichtigung der kristallographischen und chemischen Grenzgebiete. By Prof. E. Sommerfeldt. Pp. xi+192. (Berlin: Gebrüder Borntraeger, 1911.) Price 4.80 marks.

THIS little book is a veritable *multum in parvo*. It is astonishing how much information Prof. Sommerfeldt has succeeded in compressing into so small a compass; he has covered practically the whole range of physics and chemistry so far as these subjects may be applied